ON THE OCCURRENCE OF A PARASITE OF THE PIKE IN EUROPE, *MYXIDIUM LIEBERKÜHNI* BÜTSCHLI, IN THE PIKE ON THE AMERICAN CONTINENT AND ITS SIGNIFICANCE.

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CONTENTS.

1. INTRODUCTION.

In a previous paper (Mavor, 1916*b*) the author has recorded the occurrence of what he believed to be *Myxidium lieberkühni* Bütschli in the urinary bladder of the Pike, *Lucius lucius* L. from the Georgian Bay. The parasite was then identified on the basis of the structure of the plasmodial stage, and two spores which were all the author was able to find at that season of the year, July.

While searching for the parasite in a pike caught in Lake Mendota, Wisconsin, on May 5, 1916, he was able to find abundant spores and stages in the sporogenesis. This material forms the basis of the present paper.

2. FINDINGS IN FRESH PREPARATIONS.

The plasmodial stage was very abundant in the urinary bladder. When this was examined the urine had been evacuated and what little remained upon being withdrawn with a pipette held close to the inner surface of the bladder was filled with plasmodia. These with the exception of a few larger forms were almost uniformly spherical in shape and ranged from 10 μ to 80 μ in diameter. Many of these show areas on their surfaces

where tufts of fine short pseudopodia come off, a condition which was found even in the smallest of the pseudopodia, Pl. I., Fig. 1. In all the plasmodia a clear differentiation into ectoplasm and endoplasm could be seen, but evidence of the mesoplasm was not found, which was also the case in the parasite recorded from the Georgian Bay (Mavor, 1916b). The yellowish globules indicated by clear circles (Pl. I., Figs. 1, 3, 4) showed their probably oily nature by flowing together in plasmodia which had remained in the excised and decomposing urinary bladder for about 40 hours. Crystals of a hæmatoid nature were of rather rare occurrence and were found only in the smaller plasmodia and of these usually only in those not containing spores.

The *spores* occur in the plasmodia in pairs and lay so that their concave surfaces are in juxtaposition (Pl. I., Figs. 2 and 4). The shape of the spores of this species has been described by Bütschli (1882), Thelohan (1895), Cohn (1896), and Mavor (1916*b*). It is that of a spindle slightly curved so that when viewed from the side (Pl. I., Fig. 2), the spore appears crescent-shaped. The surface of the spore is marked with longitudinal striations converging toward the ends. The polar capsules are situated at either end of the spindle and each occupies rather less than one third of the length of the spore. In the preparations studied by the author, the polar filaments can be easily seen within the capsules in the fresh state as a spiral of four or five coils. They were extruded under the action of concentrated sulphuric acid but remained in the capsules when treated with a solution of iodine in potassic iodide and when treated with ammonia water. The sporoplasm occupies the central portion of the spore and contains two or more highly refractive bodies thought to be nuclei. The average dimensions of ten spores were found to be:

Length	18–19 μ
Width	5–6 μ
Length of Polar Capsules	5 μ
Width of Polar Capsules	2.5–3.0 μ
Length of polar filaments	40–45 μ

3. Findings in Stained Preparations.

The material was fixed in hot Schaudinn's fluid and stained with either borax-carmine, Delafield's hæmatoxylin, or Giemsa's stain. For the method used in applying the latter see Mavor (1916*a*).

The myxosporidia were found to contain nuclei of two sizes; larger nuclei measuring 2.5 μ in diameter and smaller nuclei 1.2 μ in diameter. No essential differences of structure were observed in these nuclei and no difference could be observed in their reaction to Giemsa's stain as was found by the author to be the case in the nuclei of *Ceratomyxa acadensis* (Mavor, 1916*a*). There are two kinds of granules evident in preparations stained with Giemsa's stain and they show the same reactions as described by the author in his previous paper (Mavor, 1916*b*).

The sporogenesis follows in its later stages the method described for *Myxobolus pfeifferi* by Keysselitz (1908). The sporoplasm of the fully formed spore contains two nuclei.

4. The Significance of the Occurrence of Myxidium Lieberkühni in America.

There can be little doubt that the myxosporidia of fishes are without an intermediate host. Their life-cycle consists of a period spent in the body of the host-fish alternating with a period during which the spores are free in the water or are passing unaffected through the digestive tract of some other aquatic animal. There are three ways in which their geographical distribution may be extended; (1) the spores may be carried in currents of water, (2) the spores may be carried in the digestive tract of aquatic animals, (3) all stages may be carried by the host-fish and accompany it in its wanderings. That the spores could be carried from the fresh water of one continent to the fresh water of another continent by either of the first two methods seems unlikely. It would seem therefore probable that *Myxidium lieberkühni* has followed in its distribution the wanderings of its host *Lucius lucius*.

Lucius lucius is a very old species. "Remains of the common pike occur in abundance in quaternary deposits" (Gunther, 1880, p. 624). Furthermore, not only the genus but the family,

Esocidæ, is known only from fresh water. "Fossil pike, belonging to the existing genus, have been found in the fresh water chalk of Oenigen and the diluvial marl of Silesia" (Gunther, 1880, p. 624).

If then the distribution of *Myxidium lieberkühni* over both Europe and America dates from the time when *Lucius lucius* attained that distribution it too must be an old species, and like its host have remained unmodified through a long period.

A somewhat parallel condition is found in the *Mallophaga*, the insect parasites of birds, where a very close relation exists between parasite and host. "But it is to be noted that in practically all the cases of the common occurrence of a Mallophagan species on two or more host-species, whether these host species are of the same or neighboring regions or restricted to different continents where this commonness cannot be explained by the possibility of a meeting and actual contact of individuals of the different host-species, the distinct host-species are closely allied, that is, are usually both of the same genus. And I believe that the explanation of this condition is that the Mallophagan species has persisted unchanged on two or more diverging host-species from their common ancestor. In ancient times, geographical races arose within the limits of the ancestral host-species; these races or varieties have now come to be distinct species, distinguished by superficial differences in color and markings of plumage, etc. But the parasites of the ancient hosts have remained unchanged; the plumage as food, the temperature of the body, practically the whole environment of the insects, have remained the same; there has been no external factor at work tending to modify the parasitic species, and it exists today in its ancient form, common to the newly arisen descendants of the ancient host" (Vernon L. Kellogg, 1908, p. 3).

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EXPLANATION OF PLATE.

PLATE I.

Myxidium lieberkühni Butschli from the urinary bladder of *Lucius lucius*. All drawings made with the camera lucida from fresh preparations of the urine.

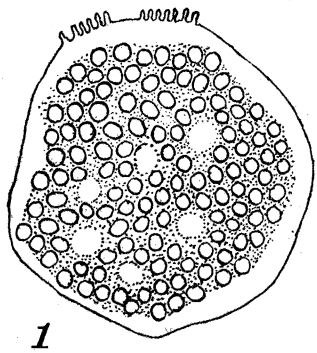
FIG. 1. Plasmodial stage showing fine pseudopodia for attachment to bladder wall. × 880.

FIG. 2. Two spores as arranged in pansporoblast. × 4,000.

FIG. 3. Small plasmodial stage showing hæmatoidin crystal. × 880.

FIG. 4. Plasmodial stage showing two pansporoblasts each containing two spores. × 880.

FIG. 5. Single spore showing sporoplasm and polar filaments. × 4,000.



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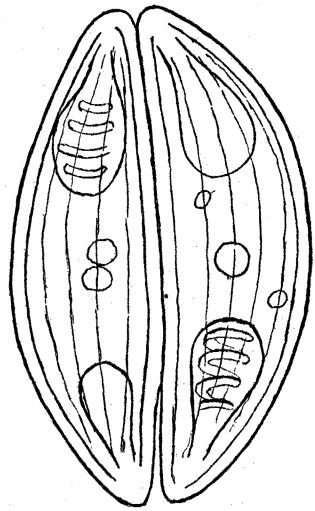

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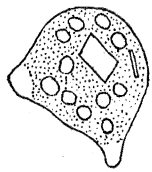

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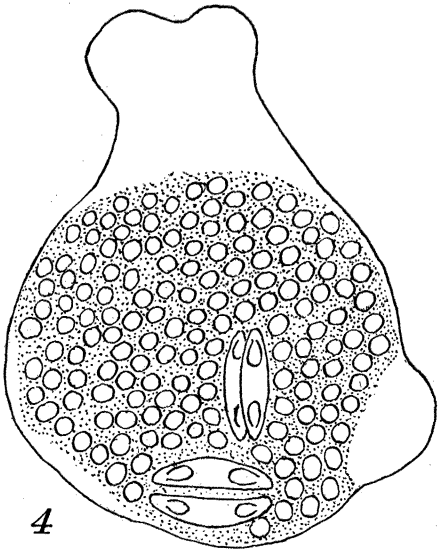

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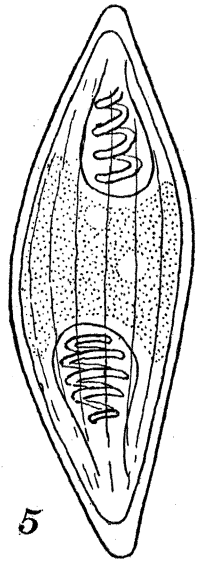

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